EVALUATION OF ACCURACY OF TWO DIFFERENT APEX LOCATORS FOR DETERMINING THE WORKING LENGTH DURING ROOT CANAL RETREATMENT WITH TWO DIFFERENT FILE SYSTEMS: AN IN VITRO STUDY

INTRODUCTION:
Endodontic retreatment requires regaining access into the root canal system through complete removal of the endodontic obturating material. Thorough chemomechanical reinstrumentation and disinfection of the root canal system is the pre-requisite for successful retreatment. Accurate working length determination is a crucial part of successful endodontic treatment.

Apical constriction, which is the narrowest part of the root canal and the connection site of periodontal and pulpal tissues is the recommended point for the apical terminal of working length. There are different methods for determining the working length like radiography, tactile method and electronic apex locators (EALs). To date, radiographs are the most commonly used technique but they are subjected to distortion, magnification, lack of three-dimensional representation, increased radiation exposure to the patient and it is timeconsuming. However, with the introduction of the electronic apex locators, this problem can be solved as it works on the electronic principle and can determine the treatment and retreatment working length up to the minor foramen.

An accurate working length determination during the retreatment process will make it easier for an operator to completely remove the primary root canal filling material. It has been shown that root canal preparation and root canal filling materials affect root canal impedance which is a sharp change at the apical terminus that is recognized by recent EALs as the apex. As per our knowledge, there are few studies that have evaluated the accuracy of different EALs during endodontic retreatment of canals obturated with different endodontic materials. However, there are very few studies which have evaluated accuracy of EALs during retreatment using two different file systems.

The aim of this study is to evaluate accuracy of two different apex locators for working length determination during root canal retreatment with two different file systems.

MATERIALS AND METHODS:
A total of 40 extracted, single-rooted premolars were selected for the study. Teeth with single canals, morphologically normal, and no evidence of fracture or resorption were included in the study while teeth with carious roots, external or internal root resorption, and open apex roots were excluded from the study. External debris was removed using ultrasonic scaler. Access cavity preparation was done using high-speed diamond fissure bur (Mani, Tochigi, Japan). The occlusal surface was ground slightly to flatten it so as to achieve a stable reference point for accurate measurements. Size #15 K-file (Mani, Tochigi, Japan) was used for pulp debridement. 15-K file was introduced into the canal until it became visible at the apex. Silicon stop was accustomed at the reference point and the length between stop and tip was calculated using Vernier caliper to the nearest 0.5 mm. The measurements were repeated three times and mean was calculated. This length achieved is called as tooth length (TL) and after deducting 1 mm, the length established is the actual working length (AWL).

Biomechanical preparation was done using ProTaper Next (Dentsply Maillefer, Ballaigues, Switzerland) upto D2 using manufacturer’s instructions. Irrigation was done using 5.25% Sodium hypochlorite (Dentpro, India). Paper points were used to dry the canals. The teeth were obturated using gutta-percha with Sealapex (Sybron Endo, Sybron Endo Specialities, Glendona, CA, USA) using single cone technique. Cavity was sealed with temporary restorative material and the samples were incubated for 7 days. After 7 days, the samples were divided into two groups and underwent retreatment with two different file systems.

Group I (n=20): In this group, the obturating material was removed using ProTaper retreatment files (Dentsply Maillefer, Ballaigues, Switzerland). Removal from coronal third was done with D1 file while D2 file was used for the removal from the middle and D3 to the working length.

Group II (n=20): In this group, the obturating material was removed using R-Endo (Micro-Mega, Besancon, France). Re is the orifice opener, R1 was used till the cervical third, R2 till the middle third and R3 up to working length.

Sodium hypochlorite was used for irrigation after removing the obturating material. With the help of radiographs, amount of gutta percha remained in the canal was calculated.

Alginate was used as the conducting media so as to simulate periodontal ligament for measuring the working length. The roots of the teeth and the lip clip of the apex locator were embedded into alginate so as to complete the circuit.

These groups were further divided into subgroups:
- Subgroup IA: Root ZX (J. Morita Co., Kyoto, Japan) apex locator was used for the measuring the working length
- Subgroup IB: i-Root (S-Denti, Seoul, Korea) apex locator was used for measuring the working length
- Subgroup IIA: Root ZX (J. Morita Co., Kyoto, Japan) apex locator

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was used for the measuring the working length.

- Subgroup IIA: i-Root (S-Dentis, Seoul, Korea) apex locator was used for measuring the working length.

**Working length determination using apex locators:**

For Root ZX apex locator, #15 K-file was used for the measurement of working length till the lowest part of the green bar on the apex locator screen. For i-Root apex locator, the measurements were made when the screen showed ‘apex’. The length between the stopper and the tip was measured. Three measurements were made and mean was calculated. The values were compared with AWL.

Data were calculated in the tabulated form and were subjected to statistical analysis. One-way ANOVA test was used to evaluate the values which revealed the mean difference values of all the groups followed by post-hoc test.

**RESULTS:**

One-way ANOVA showed significant values in group IA and group IB in determining the working length that were treated with ProTaper retreatment files and no significant difference was seen in group IIA and group IIB that were treated with R-Endo retreatment files.

**Table 1: Mean difference between retreatment working length in subgroups where working length was measured using Root ZX and i-Root apex locator.**

<table>
<thead>
<tr>
<th>Group Name</th>
<th>Components</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>F</th>
<th>df</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group IA</td>
<td>Root ZX</td>
<td>10</td>
<td>18.486</td>
<td>2.623 55</td>
<td>2</td>
<td>0.003; significant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>i-Root</td>
<td>10</td>
<td>18.720</td>
<td>2.025 79</td>
<td>2</td>
<td>0.021; significant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Digital Caliper</td>
<td>10</td>
<td>18.747</td>
<td>2.113 19</td>
<td>2</td>
<td>0.227; Not significant</td>
<td></td>
</tr>
<tr>
<td>Group IB</td>
<td>Root ZX</td>
<td>10</td>
<td>18.486</td>
<td>2.623 55</td>
<td>2</td>
<td>0.021; significant</td>
<td></td>
</tr>
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<td>2.113 19</td>
<td>2</td>
<td>0.227; Not significant</td>
<td></td>
</tr>
<tr>
<td>Group IIA</td>
<td>Root ZX</td>
<td>10</td>
<td>18.486</td>
<td>2.623 55</td>
<td>2</td>
<td>0.021; significant</td>
<td></td>
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</tr>
</tbody>
</table>

Wilcox et al showed that if solvents are used the removal of obturating material deposited on the walls of root canals becomes difficult. Also, it may alter the antimicrobial properties of the irrigants. In this study, two file systems, ProTaper retreatment files and R-Endo retreatment files were used for removing the obturating materials. ProTaper retreatment files have been introduced to facilitate removal of the filing material faster and safer. The D1 instrument has an active tip that aids an initial entrance into the obturating materials. Also, it has long pitch angle which allows higher cutting speed and more efficient debris removal. D2 and D3 are more flexible, present longer lengths since they are meant to reach the apical thirds. R-Endo instruments have cross section which is characterized by three equally spaced cutting edges and has neither radial lands nor active tips. Alginate is an electroconductive material, which simulates periodontal ligament with its colloidal consistency. The present study utilized alginate as a conductive media.

In the present study, Root ZX showed better results as compared to i-Root, possibly because the residual root filling material occluding the dentinal tubules predisposes to a reduction in electrical conductivity and an increase in impedance, a factor which is responsible for enhancing the electrical detection of the apical file. When the result of ProTaper and R-Endo retreatment system was combined with that of the Root ZX and i-Root apex locator, Root ZX with ProTaper retreatment files proved to have better results as compared to i-Root with R-Endo retreatment files with significant values. The accuracy of Root ZX was found to be 65% while that of i-Root apex locator was 22.5% ± 0.5 mm from the actual length.

**CONCLUSION:**

Within the limitations of our study, the apex locators can be successfully used to determine the working length in endodontic retreatment. Under the parameters of our study, Root ZX apex locator was more accurate as compared to i-Root apex locator in determining the working length in teeth after removing the root canal obturating material.

**REFERENCES**

